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DEPARTMENT OF TRADE AND INDUSTRY  
DEPARTEMENT VAN HANDEL EN NYWERHEID

REPUBLIC OF SOUTH AFRICA



REPUBLIEK VAN SUID-AFRIKA

**LETTERS PATENT**  
(PATENTS ACT, 1978)

**PATENTBRIEF**  
(WET OP PATENTE, 1978)

No. 99/2714

WHEREAS **ANDERSON, LLEWELLAN, GIBSON, JOHN ALLEN**  
NADEMAAL

(Hereinafter called "the Patentee")  
(Hieronder "die Patenthouer" genoem)

has applied to me for the grant of a patent in respect of an invention described and claimed in the complete specification  
aansoek by my gedoen het om die verlening van 'n patent ten opsigte van 'n uitvinding wat beskryf is en waarop aanspraak

deposited at the Patent Office under the above-mentioned number, a copy of which is annexed, together with the relevant  
gemaak word in die volledige spesifikasie wat by die Patentkantoor onder bovermelde nommer ingedien is en waarvan 'n

Form P. 2;  
afskrif aangeheg is tesame met die betrokke Vorm P. 2;

NOW THEREFORE these Letters Patent are to grant to the Patentee a patent, the effect of which shall be to grant to the  
SO IS DIT dat hierdie Patentbrief aan die Patenthouer 'n patent verleen wat die uitwerking het dat, behoudens die  
Patentee in the Republic, subject to the provisions of the Act, for the duration of the patent, the right to exclude other persons  
bepalings van die Wet, aan die Patenthouer vir die duur van die patent in die Republiek die reg verleen word om ander  
from making, using, exercising or disposing of the invention, so that he shall have and enjoy the whole profit and advantage  
persone uit te sluit van die vervaardiging, aanwending, uitoefening of van die handsetting van die uitvinding, sodat hy al die  
acruing by reason of the invention.  
as en voordeel wat uit die uitvinding voortspruit, verkry en geniet.

IN TESTIMONY WHEREOF the seal of the Patent Office has been affixed at Pretoria with effect from the  
TER BETUIGING WAARVAN die seël van die Patentkantoor hierop te Pretoria aangebring is met ingang van die

29 day of December  
dag van

nineteen hundred and  
eenduisend negehonderd

NINETY NINE

*Lidner*  
Registrar of Patents - Registrateur van Patente

15m overleaf

**PATENT**

1. The patent remains in force only if the required renewal fees are paid annually after the third year of the date of application.  
Die patent is geldig slegs indien die vereiste hernuwingsgelde jaarliks, na die derde jaar vanaf die datum van aansoek betaal word.
2. This document is not valid unless sealed with the seal of the Patent Office, PRETORIA.  
Hierdie dokument is nie geldig nie tensy geseël met die seël van die Patentkantoor, PRETORIA.

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FORM P.2

REPUBLIC OF SOUTH AFRICA		REGISTER OF PATENTS		PATENTS ACT, 1978	
OFFICIAL APPLICATION NO.		LODGING DATE: PROVISIONAL		ACCEPTANCE DATE	
21	01	99/2714		22	47 25-10-99
INTERNATIONAL CLASSIFICATION		LODGING DATE: COMPLETE		GRANTED DATE	
5	E21C	23	14th April 1999	99S	
FULL NAME(S) OF APPLICANT(S)/PATENTEE(S)					
71	ANDERSON, LLEWELLAN GIBSON, JOHN ALLEN				
APPLICANTS SUBSTITUTED:				DATE REGISTERED	
71					
ASSIGNEE(S)				DATE REGISTERED	
71					
FULL NAME(S) OF INVENTOR(S)					
72	ANDERSON, Llewellyn; GIBSON, John Allen				
PRIORITY CLAIMED		COUNTRY		NUMBER	
N.B. Use International abbreviation for country (See Schedule 4)		33	ZA ZA	31	98/3086 98/8715
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TITLE OF INVENTION					
54	MINING MACHINE				
ADDRESS OF APPLICANT(S)/PATENTEE(S)					
16042 - 160th Place SE, Renton, WA 98058, United States of America 4840 NE 40 ST, Seattle, WA 98105, United States of America					
ADDRESS FOR SERVICE				J & K REF:	
74	JOHN & KERNICK, Waterfall Park, Midrand				P 13637 ZA
PATENT OF ADDITION NO.		DATE OF ANY CHANGE			



Form P2  
Continued

FORM P7

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PATENTS ACT, 1978JOHN & KERNICK  
P O Box 3511  
HALFWAY HOUSE  
1685

## COMPLETE SPECIFICATION

(Section 30(1) - Regulation 28)

21	01	Official Application No	22	Lodging Date	47	J & K Reference
		992714		14th April 1999		P 13637 ZA
51		International Classification				
		E21C				
71		Full name(s) of applicant(s)				
		ANDERSON, LLEWELLAN GIBSON, JOHN ALLEN				
72		Full name(s) of inventor(s)				
		ANDERSON, Llewellan; GIBSON, John Allen				
54		Title of Invention				
		MINING MACHINE				

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**"MINING MACHINE"****FIELD OF THE INVENTION**

This invention relates to a mining machine for mining ore from narrow reefs without the use of explosives.

**BACKGROUND TO THE INVENTION**

The hazards of underground mining and particularly hard rock mining at deep levels are well known. The costs of such mining operations are also very high, not the least because of the quantity of rock that is mined using the conventional labour intensive drilling and blasting techniques. The selectivity of ore from waste rock where gold and platinum is mined is poor using such mining techniques resulting in treatment of large quantities of rock bearing no values.

These difficulties have been addressed in many ways over a long period without any really successful mechanised non-explosive stoping having been achieved.

**OBJECT OF THE INVENTION**

It is the object of this invention to provide a mining machine which can be used effectively in hard rock mining conditions.

### SUMMARY OF THE INVENTION

According to this invention there is provided a mining machine comprising a cutter head supported on the end of a boom rotatably mounted at its other end on an anchorable support itself connected to a further releasable anchor and including hydraulic means for rotating the boom around the anchorable support and for extending the cutter head relative to at least one of the releasable anchor and the anchorable support there being further means for separately anchoring the boom.

Further features of this invention provide for the anchors to be provided by hydraulic actuators with the releasable anchor provided by a pair of hydraulic actuators spaced apart laterally with respect to the rotatable mounting for the boom and for the rotatable mounting to be carried on a support beam extending from the releasable anchor.

Still further features of this invention provide for the boom or the support beam or both to be extensible to extend the cutter head away from the releasable anchor, for the rotation of the boom to be effected by at least one further hydraulic actuator extending between the releasable anchor and the boom and for there to be at least one clevis projecting from the boom connectable to the further hydraulic actuator.

Yet further features of this invention provide for there to be a pair of booms angularly spaced apart extending from and rotatable around the anchorable support, for each boom carrying a separate cutter head, and for the booms to be normal to each other and individually extensible.

The invention also provides for the cutters to be rolling type kerf cutters, for the cutter heads to be shaped to give a predetermined shape to the excavation and for the cutters to be mounted in the cutter head in a manner providing support for the cutters against movement of the cutter head in opposite directions.

Still further features of this invention provide for a lashing plough to be provided, on each side of each cutter head. The invention provides further a cutter head for a mining machine as defined.



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### BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of this invention will become apparent from the following description of preferred embodiments thereof where reference is made to the accompanying diagrammatic drawings showing in

- Fig 1 an oblique view of mining machine;
- Fig 2 a plan view on a reduced scale;
- Fig 3 an oblique view of a machine having a pair of extensible booms;
- Fig 4 a similar view to Fig 3 with an extensible beam;
- Figs 5-8 are modified versions of the embodiments illustrated in Figs 1 to 4.

### DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWING

As illustrated in Figs 1 and 2 the mining machine consists of a cutter head (1) fitted with rolling type kerf cutters (2). The head (1) is fitted to the forward end of a swinging boom structure (3). The rear end of the boom (3) is rotatable about an anchorable support formed by a vertically arranged hydraulic actuator with its axis at right angles to the length of the boom (3). The boom (3) will be mounted on the cylinder of the actuator (4) which will have a hanging wall engaging head (5) and a footwall engaging foot (6).

A further vertical hydraulic actuator (7) is provided at the front end of the boom so that this end may also be anchored between the hanging and footwalls.

Extending from the actuator (4) in a generally opposite direction to the boom (3) is a telescopic support beam (8) controlled by further hydraulic actuators (9). The beam (8) and actuators (9) are carried at their ends remote from the actuator (4) by a further pair of vertically operable hydraulic actuators (10). The actuators (10) are spaced apart on opposite sides of the end of the support beam (8).

Boom (3) rotating actuators (11) extend from a frame on the support beam (8) and actuators (10). There is one actuator (11) extending along each side of the support beam (8) only one of which is operably connected to the boom (3) at a time. The connection of the actuators (11) to the boom (3) is by means of a releasable connection to a clevis indicated at (12). Referring to Fig 2 it will be seen that pivotable clevises are provided one on each side of the boom. Each clevis is connected to one of the actuators (11). To bring a clevis (12) and associated actuator (11) into operative effect to rotate the boom (3) in either left

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hand or right hand direction, a releasable link (14) is connected between the appropriate clevis (12) and the boom (3).

It will be seen from Fig 1 of the drawings that the support beam extending actuators (9) are provided in pairs one pair on each side of the beam with the actuators of each pair one above the other.

Hinged lashing ploughs (13) are provided one on each side of the cutter head (1).

In use the machine is set up in a drive at a stope face with the axis of the support beam (8) set up along the desired direction of cut and with one of the boom rotating actuators (11) secured to a linked clevis (12). This actuator is set so that the rolling cutters (2) can be forced into the stope rock face along an arcuate path around the end of the boom (3).

To enable this to be done the anchoring hydraulic actuator (4) at the rear of the boom (3) and the actuators (10) at the end of the support beam (8) are extended to anchor between the hanging and footwalls of the stope.

After the rolling cutters have completed their arcuate cut the support beam (8) is extended by means of the hydraulic actuators (9) with the actuator (4) at the end of the boom (3) released. When the support beam (8) has been extended to the required depth of the next cut, the support beam is re-anchored and the arcuate cutting operation repeated using the boom rotating actuator (11).

This operation is repeated until the support beam (8) is fully extended. The beam (8) is then retracted by keeping the actuator (4) anchored while the actuators (10) are released and the beam extending actuators (9) retracted to move the actuators (10) to a new anchoring position.

In this manner the machine is made to penetrate into the stope face to the next drive in the mine working.

When this extent of mining is reached, the machine is turned by sequentially actuating the boom actuator (7), the pivot actuator (4) and the rear support actuators (10). In this way the machine advance axis is turned through ninety degrees. This manoeuvre can be done within the width of the cut made by rotating the cutters around the pivot actuator (4).

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The machine is then advanced perpendicular to the previous mining direction by the cutting action above described. When the machine is advanced into the rock sufficiently to provide enough space, it is again turned through ninety degrees. The axis of advance is now at 180 degrees to the initial mining direction. To enable cutting to be carried out along a path in the opposite direction to the initial cut, the link (14) is released from the first clevis (12) and positioned between the other clevis (12) and boom (3) on the opposite side. This allows the boom (3) swing arc to be mirrored about the advance axis, thereby allowing left hand or right hand boom arc swings. The mining process is repeated until the machine has moved back along the full extent of the stope length.

The removal of cuttings from the face of the cut is performed by the hinged lashing plows (13) attached to the cutter head (2). These plows (13) are hinged in such a way as to ensure that cleaning is always done to the open side of the cut where conventional mine cleaning operations take over. The hinging action can be altered to accommodate either left hand or right hand boom arc swings.

Steering of the machine is carried out by extending and retracting the appropriate rear support actuators (10) to maintain the desired line and grade. Vertical steering of the machine is accomplished by extending or retracting the rear actuators (10) together. The machine pivots about the support foot (6) and the boom swing arc is raised or lowered. The boom swing arc plane is tilted in either a clockwise or counterclockwise direction by differentially extending and retracting the rear actuators (10). Lateral steering is accomplished by anchoring the boom (3) with the boom actuators (7) then releasing the rear actuators (10) and extending or retracting the boom swing actuators (11). This causes the line of machine advance to be altered in the horizontal plane.

Figs 3 and 4 of the drawings illustrate a machine which is basically similar in operation to that shown in Fig 2 and 3.

The machine (21) consists of a beam (22) anchorable at each end. The operatively rear end of the beam (22) has a pair of actuators (23) and (24) operable independently to anchor the rear end of the beam in varying orientations. This directs the beam as described above.

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The front end of the beam (22) is supported on a third actuator (25) which also form the pivot support for a pair of booms (26) and (27) mounted in fixed angular inclination to each other to pivot in unison about the axis of the actuator (25).

The free ends of the booms (26) and (27) carry cutter heads (28) and (29) and lashing ploughs (30). The cutting heads will be designed to give a predetermined shape to the excavation which will be made by a reciprocating movement of the heads along an arcuate path around the actuator (25) also as described above with reference to Figs 1 and 2.

Actuators (31) and (32) extend from the rear anchors (23) and (24) to fixed links (33) and (34) so that a swing movement can be imparted to the cutter heads to give a cutting movement in both clockwise and anti-clockwise directions.

As the cutters operate the cut rock will be moved to the sides of the machine by the lashing ploughs (30) adjustably fitted to the cutter heads (28) and (29).

Fig 3 shows the machine with a fixed beam (22) and extensible booms (26) and (27). This arrangement required further actuators (35) and (36) to anchor the front end of the booms to enable the booms to be extended and retracted. Further actuators indicated at (37) and (38) will be used to effect extension and retraction of the boom.

Similarly, as shown in Fig 4 the beam (22) may be extensible. Further actuators, not shown, and conveniently located within the beam will be required to extend and retract the beam.

As stated above, the machine will operate in similar manner to that described with reference to Figs 1 and 2 but the use of two booms enables an excavation to be made into a rock face as a tunnel operation.

It will be understood that in the construction shown in Figs 3 and 4 the machine will have the cutters mounted in cutter heads in a manner which will support the cutters against operational movement of the beam in both directions.

5 + 6  
Referring now to Figs 5 and 7 it will be seen that the boom (3) has been made extensible while the beam has been formed as a fixed unit. Further the clevis (12) and links (14) have been omitted and the anchoring of the piston rods of the

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actuators (11) varied along the length of the boom (3) so that rotation of the cutter head (1) around the actuator anchor (4) can be obtained.

Also the actuator (7) to anchor the end of the boom (3) adjacent the head (1) has been dispensed with and a pair of smaller anchoring actuators provided are on each end of the head (1).

Figs 7 and 8 show the machine of Figs 3 and 4 modified in a similar way to that in which Figs 5 and 6 have been modified with respect to the construction shown in Fig 1 and 2. The booms (3) have been made extensible and each cutter head (1) anchorable by means of actuators (27) on the ends of the cutter heads. Clevises (12) and links (14) have again been omitted and rotation of the heads obtained by the different location of the ends of the actuators (11).

It will be appreciated that the mining machine can be varied in many ways without departing from the scope of the invention. The kind and exact location of the actuators relative to each other can be varied to mention one example and others will be apparent to those skilled in the art.

In all the embodiments described if desired, both the booms and the beam may be extensible.

**CLAIMS:**

1. A mining machine comprising a cutter head supported on the end of a boom rotatably mounted at its other end on an anchorable support itself connected to a further releasable anchor and including hydraulic means for rotating the boom around the anchorable support and for extending the cutter head relative to at least one of the releasable anchor and the anchorable support there being further means for separately anchoring the boom.
2. A mining machine as claimed in claim 1 in which the anchors are hydraulic actuators.
3. A mining machine as claimed in claim 1 or 2 in which the releasable anchor has a pair of hydraulic actuators spaced apart laterally with respect to the rotatable mounting for the boom.
4. A mining machine as claimed in any one of the preceding claims in which the rotatable mounting is carried on a support beam extending from the releasable anchor.
5. A mining machine as claimed in claim 4 in which the boom, the support beam or both are extensible to extend the cutter head away from the releasable anchor.
6. A mining machine as claimed in any one of the preceding claims in which the boom is rotatable by at least one further hydraulic actuator extending between the releasable anchor and the boom.
7. A mining machine as claimed in any one of the preceding claims in which there are a pair of booms angularly spaced apart and extending from and rotatable around the anchorable support.
8. A mining machine as claimed in claim 7 in which each boom carries a separate cutter head.
9. A mining machine as claimed in claim 7 or 8 in which the booms are normal to each other.

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10. A mining machine as claimed in any one of claims 7 to 9 in which the booms are individually extensible.
11. A mining machine as claimed in any one of the preceding claims in which there is at least one clevis projecting from each boom connectable to the further hydraulic actuator.
12. A mining machine as claimed in any one of the preceding claims in which each cutter head has a lashing plough mounted on each side thereof.
13. A mining machine as claimed in any one of the preceding claims in which the cutters for each cutter head is a rolling type kerf cutter.
14. A mining machine as claimed in any one of the preceding claims in which the cutter heads are shaped to give a predetermined shape of excavation.
15. A mining machine as claimed in any one of the preceding claims in which the cutter heads have the cutters mounted to be supported against movement of the cutter head in opposite directions.
16. A cutter head for a mining machine the head being as defined in any one of claims 12 to 15.
17. A mining machine substantially as described and illustrated in any one of the accompanying drawings.

DATED THIS 14TH DAY OF APRIL, 1999.

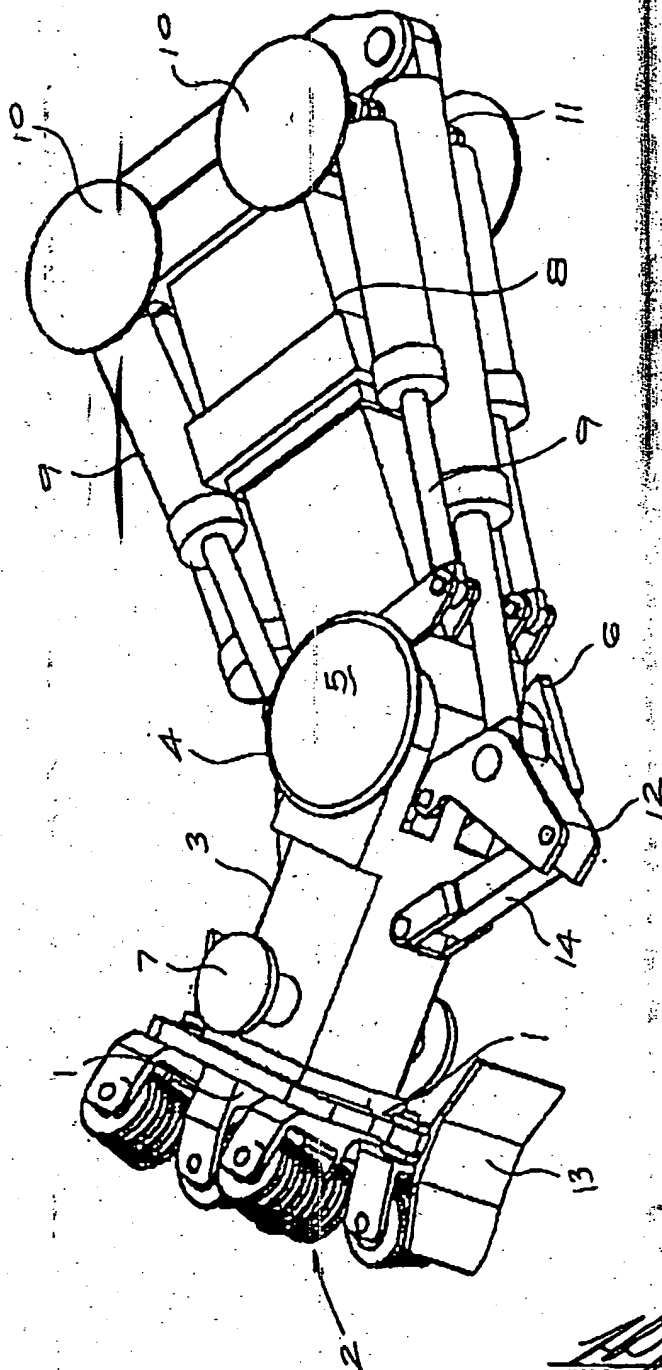
P. D. FAHRENHEIM

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For the Applicant

ANDERSON L & GIBSON J A  
COMPLETE SPECIFICATION

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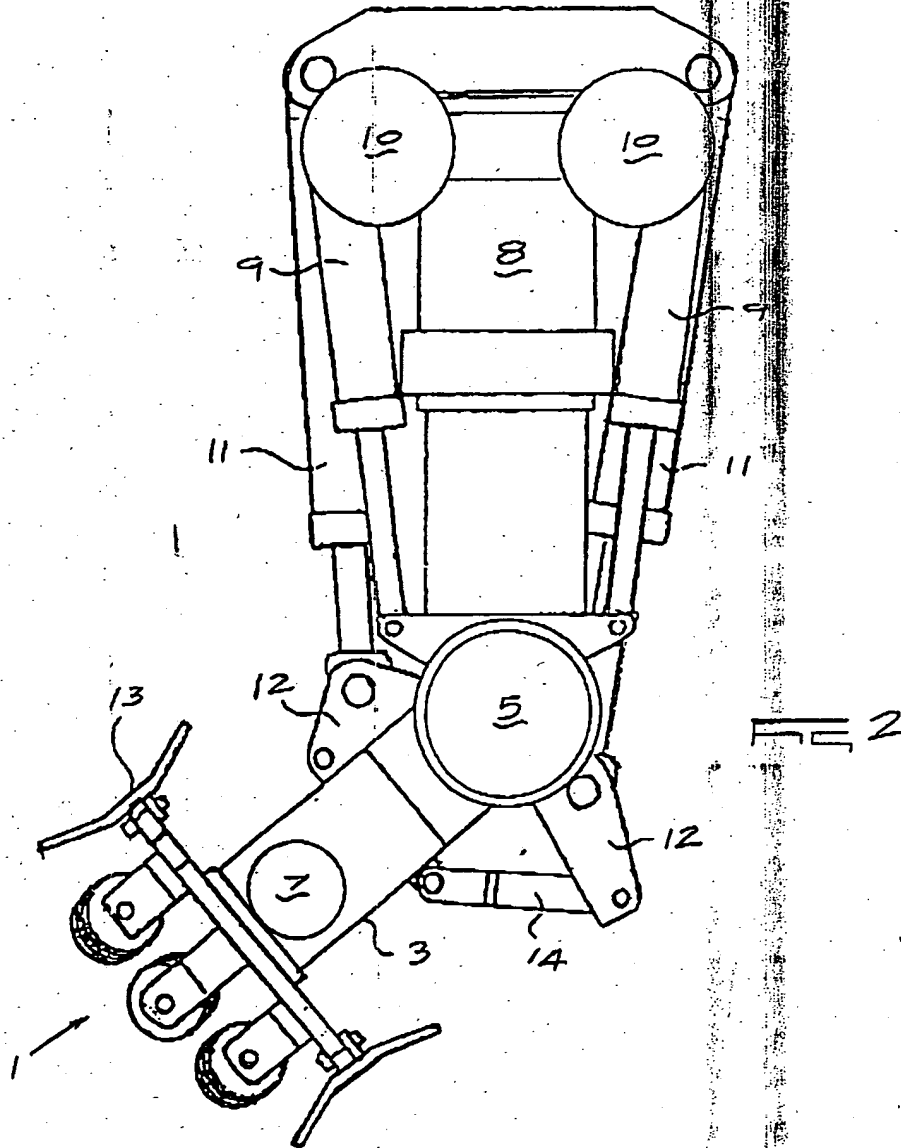


  
JOHN KERNICK  
For the Applicant



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COMPLETE SPECIFICATION

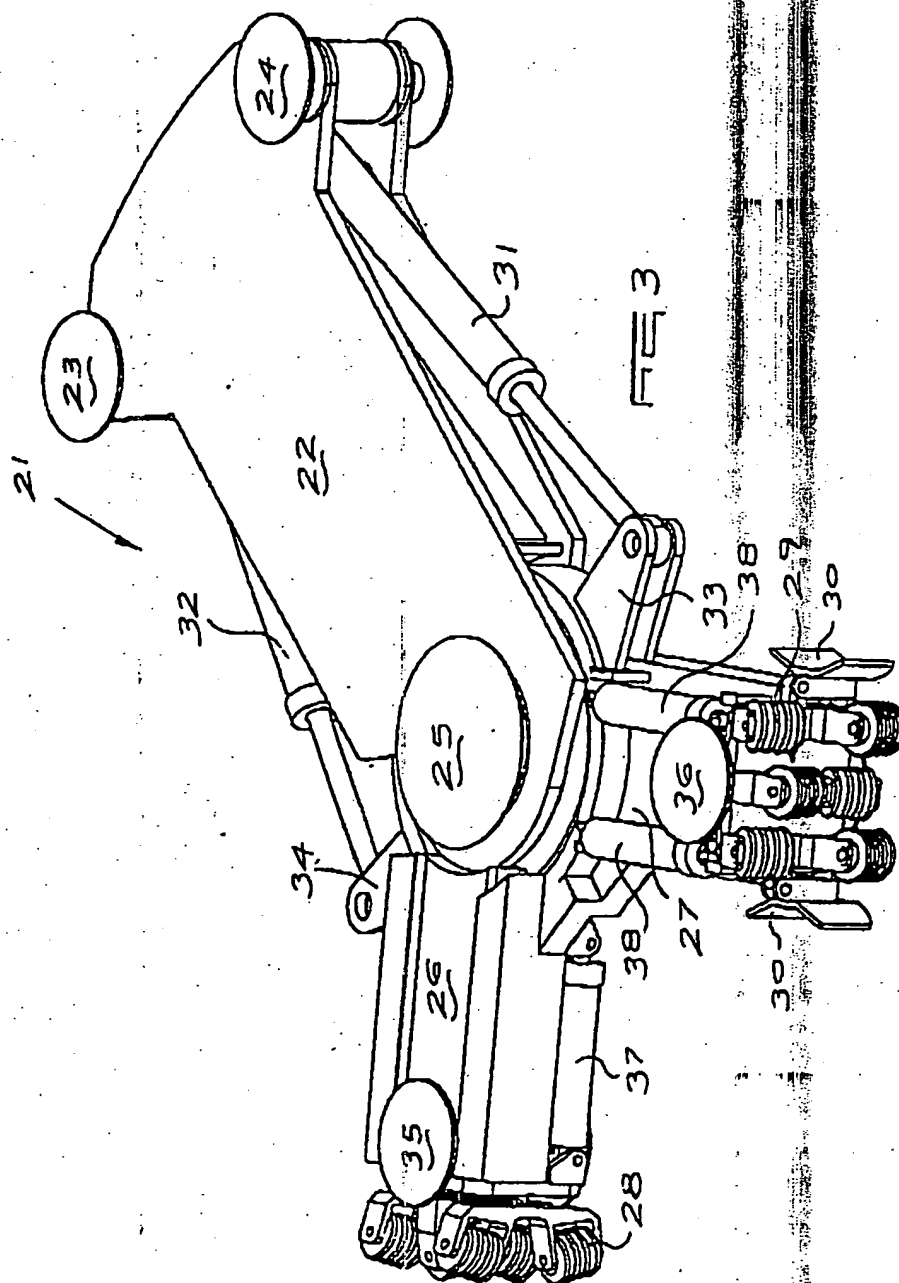
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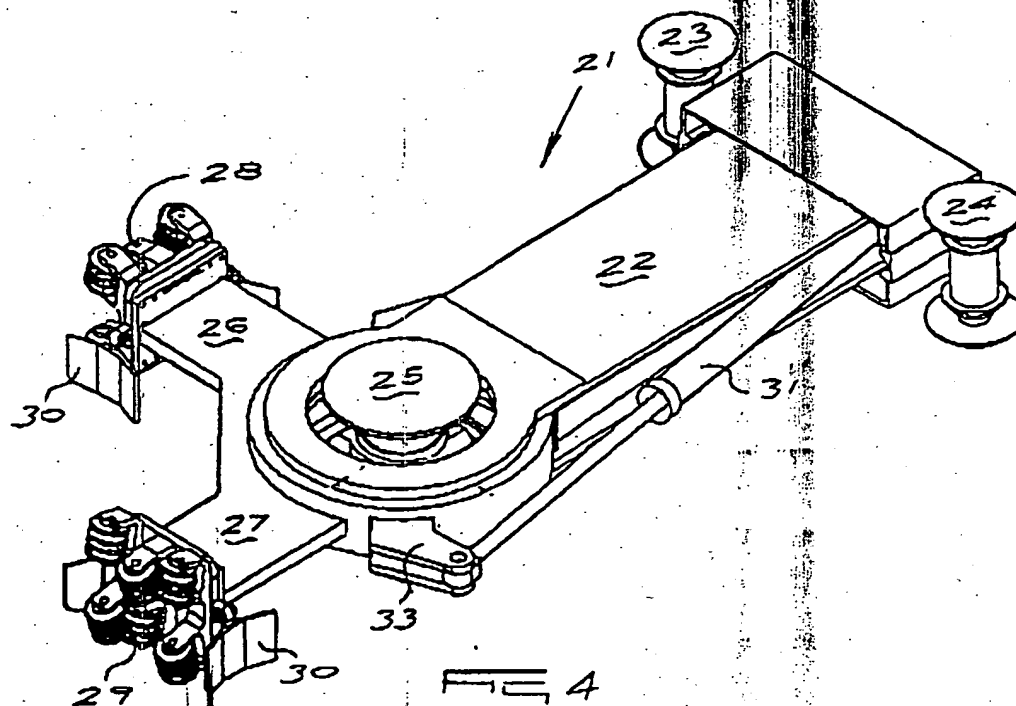
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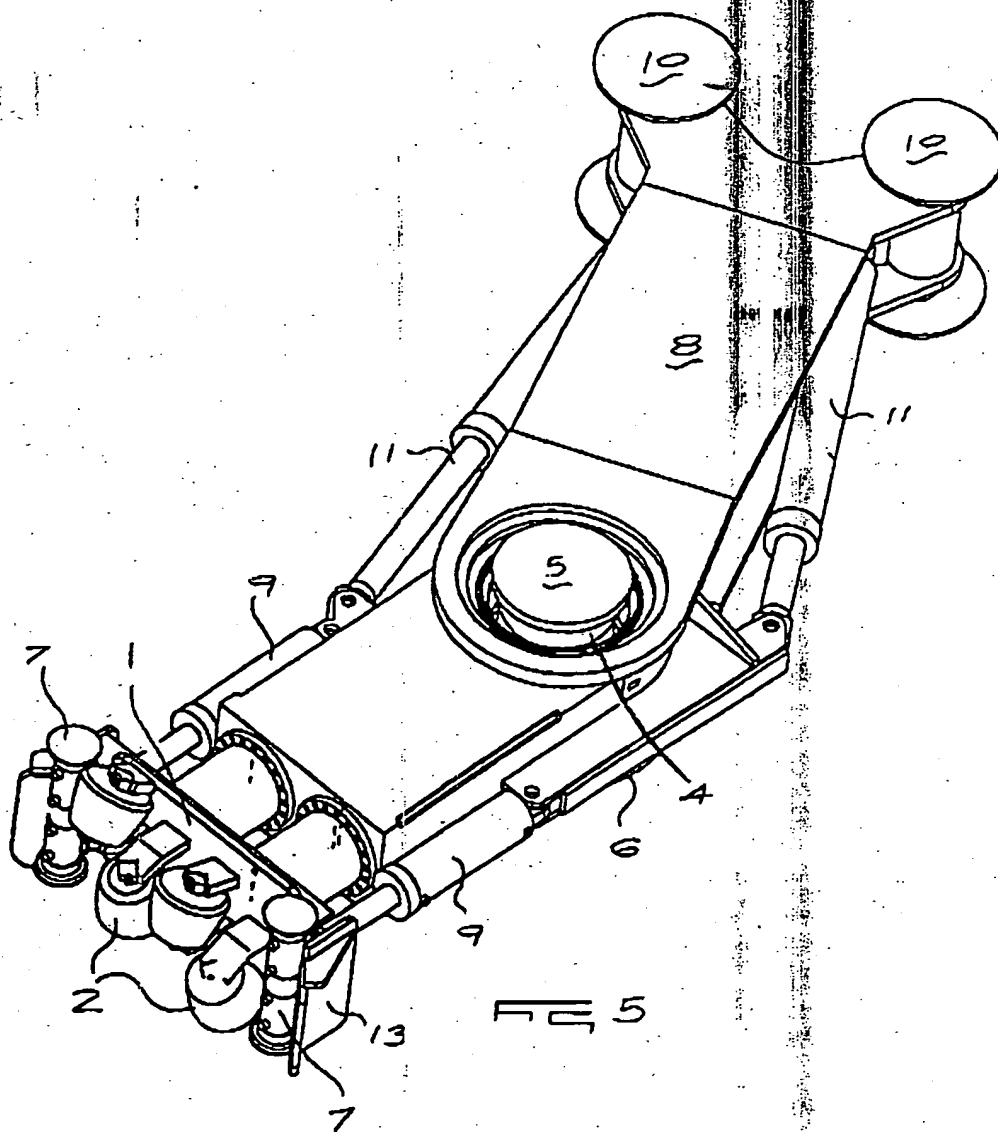
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COMPLETE SPECIFICATIONEIGHT SHEETS /  
SHEET FOUR

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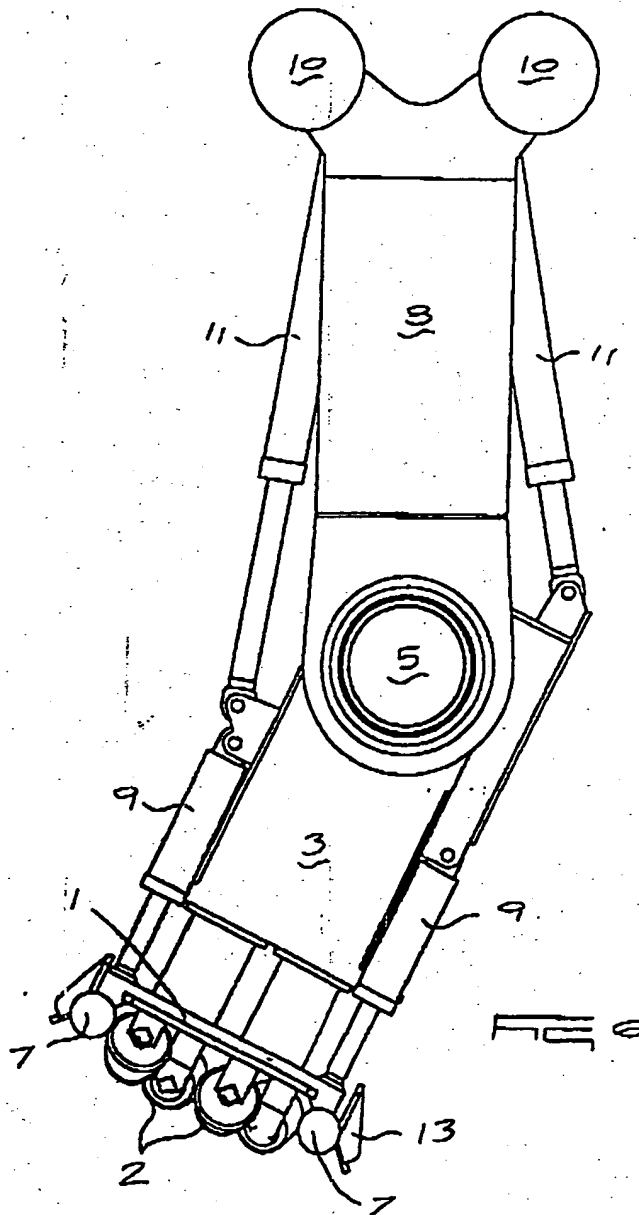
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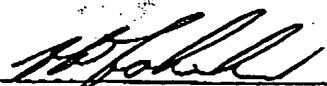


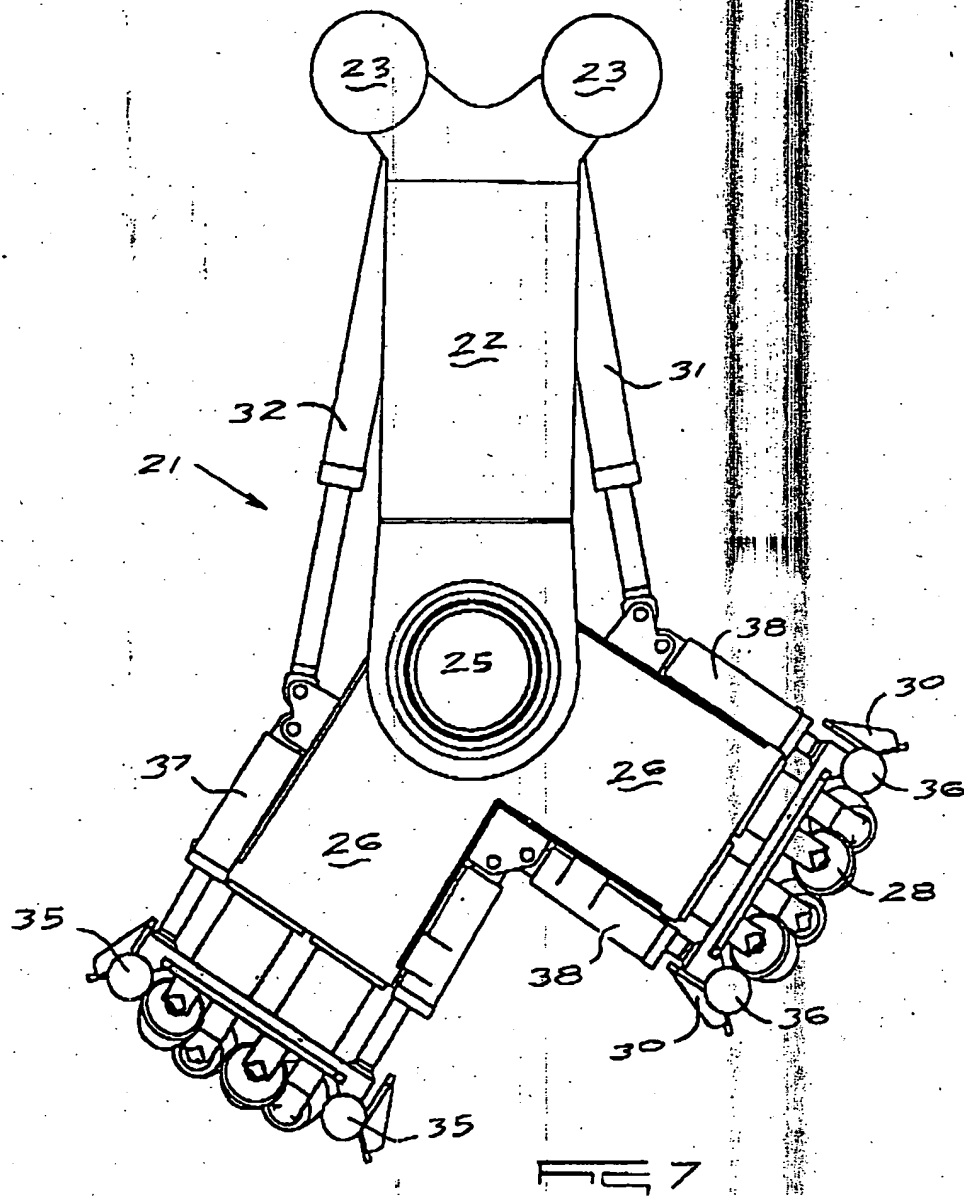
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COMPLETE SPECIFICATIONEIGHT SHEETS /  
SHEET SEVEN

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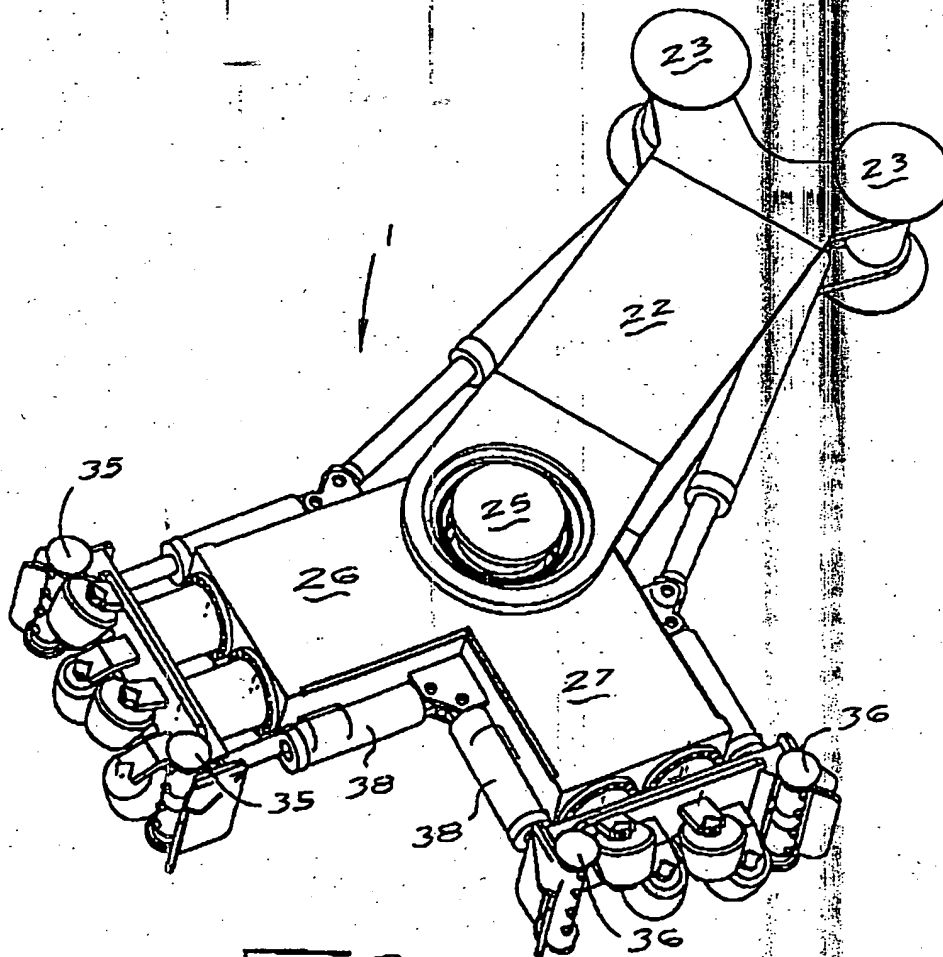


FIG 8

*John & Kernick*  
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